

## Female urinary incontinence

### ICS definitions (Abrams 2003)

*Stress urinary incontinence.* The symptom is the complaint of involuntary leakage on exertion or on sneezing or coughing. The sign is the observation of involuntary urinary loss from the urethra synchronous with exertion, sneezing, or coughing. Urodynamiс stress incontinence is noted during urodynamiс testing (filling cystometry) and is defined as the involuntary leakage of urine during increases in abdominal pressure in the absence of a detrusor contraction.

*Urge urinary incontinence.* The symptom is the complaint of an involuntary leakage accompanied by or immediately preceded by urgency. The sign is the observation of involuntary urinary loss from the urethra that is accompanied by or immediately preceded by urgency. Detrusor overactivity incontinence is incontinence related to an involuntary detrusor contraction during urodynamics.

*Mixed urinary incontinence.* The complaint of an involuntary leakage of urine associated with urgency and also with exertion, effort, sneezing, or coughing. For practical purposes initial management should be directed to the predominant symptom

### Classification of urinary incontinence

- Stress urinary incontinence (SUI)
- Urge urinary incontinence (UUI)
- Mixed urinary incontinence
- Other
  - Transient causes (DIAPERS)
  - Urethral diverticulum
  - Vesico-vaginal fistula
  - Ectopic urethrae

### Demographics

Very common

Prevalence

Stress	42 - 55%
Urge	7 - 12%
Mixed	24 - 44% (Elving, Bortolotti)

Bimodal distribution

Gradual increase to peak at menopause (~30%)

Further peak after 70 yrs (30-40%)

SUI predominates in young/middle-aged women; mixed and OAB in older patients

Whites > Blacks, Hispanics and Asians

Family history

Mother +/- sister      increased RR x3

### Stress urinary incontinence

Originally believed that 2 types of stress incontinence based on UDS findings:

Genuine stress incontinence (GSI) and intrinsic sphincter deficiency (ISD)

However, it is known that many women with urethral hypermobility are not incontinent, implying that a sphincter defect present in all.

SUI however may or may not be associated with concomitant bladder base descent, which may be important for subsequent surgical treatment.

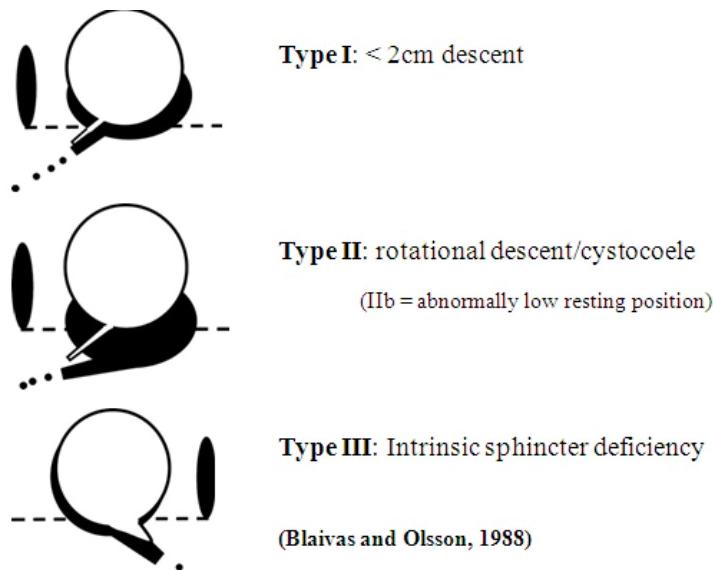
### Theories of SUI development

- (i) Urethral position theory (Kelly, Bonney, Einhorning) – failed transmission of intra-abdominal pressure to the urethra
  - (ii) Intrinsic sphincter deficiency (McGuire) – poor periurethral support tissues
  - (iii) Hammock theory (DeLancey) – lax pubococcygeus backplate
  - (iv) Integral theory (Petros and Ulmstein) – weak pubourethral ligaments
- Probably multifactorial, incorporating all features of above. Nowadays all patients considered to have ISD, with varying degrees of urethral hypermobility.

### Classification of SUI (Blaivas and Olson 1988)

Based on position of bladder base in relation to the inferior margin of the pubic symphysis (IMPS), and whether or not the BN is open at rest

Type 1	Normal position above IMPS BN closed at rest
Type 2	Leakage and descent < 2cm below IMPS Normal position, BN closed, rotational descent (cystourethrocoele) 2b = abnormally low position at rest
Type 3	Previously ISD Normal position BN open at rest



Differentiation on the basis of clinical examination, video UDS, Valsalva leak point pressure, and urethral pressure profiling

### Urethral hypermobility

Bladder base descent leads to urethra exiting true pelvis. Thus raised intraabdominal pressure unequally transmitted to bladder vs. urethra and leakage occurs

Risk factors for urethral hypermobility

- Pregnancy (esp. prolonged labour)
- Vaginal delivery (esp. instrumental)
- Pelvic surgery
- Obesity
- Chronic cough
- Chronic constipation
- Autonomic neuropathy (DM, MS, Shy-Drager)

### Sphincter deficiency without descent (ISD)

Bladder neck already open at rest; thus very low increase in intraabdominal pressure results in urinary leakage

Risk factors for pure ISD

- Neuropath
- Trauma or previous surgery
- Radiation
- Poor oestrogenisation

## **Evaluation of Stress Urinary Incontinence**

History (as above)

- Family history
- Medical history
- Obstetric history

Clinical examination

- Abdominal exam (? retention)
- Abbreviated neurological examination
- Stress test
- Speculum evaluation
- Vaginal grip  
(Q-tip test)  
(Bonney test)  
(Marshall test)

Additional tests

- Urinalysis
- Post-void residual
- Frequency voiding chart
- Pad tests
- Urodynamics
  - Valsalva leak point pressure
  - Urethral pressure profile
  - With ring pessary reduction of prolapse (see POP notes)

### Clinical examination

(i) Abbreviated neurological examination

- Afferent = Perineal sensation, bulbocavernosus (but absent in 30%)
- Motor = Spreading of toes (S3)

(ii) Stress test

Observation of leakage of urine with valsalva or cough.

Should be performed in supine position; if no leak repeat in standing position

Caution – unstable bladder contraction may be stimulated by cough.

Usually suggested by short time lag between cough and leak

(iii) Speculum examination

Ideally Simms speculum in left lateral position; allows identification of anterior and posterior compartment prolapse

(iv) Vaginal examination

Excludes obvious vaginal, cervical or adnexal masses

Vaginal grip graded by Oxford grading system (Laycock 1992)

Table I Modified Oxford Grading  
(according to Laycock, L: 'Assessment  
and treatment of pelvic floor dysfunction  
[PhD]'. University of Bradford, 1992)<sup>15</sup>

0:	no contraction
1:	flicker
2:	weak
3:	moderate (with lift)
4:	good (with lift)
5:	strong (wift)

Whilst very limited evidence that vaginal grip predicts outcome of PFMT, NICE expert advice recommends grip test

(NR) Q-tip test

Lubricated ear bud in urethra. Deviation > 30 degrees diagnostic.

Unreliable and adds little to investigation

Not recommended by NICE

(NR) Bonney test

2-finger elevation of periurethral tissue to abolish leak

Very difficult to do without compressing urethra

Not recommended by NICE

(NR) Marshall test

Equivalent to Bonney test except LA and clamp to avoid inadvertent compression of urethra

Impractical and unnecessary

Not recommended by NICE

Additional tests

(i) Urinalysis

(ii) Post-void residual

(iii) Voiding diary

NICE recommends minimum of three days

(iv) Symptom questionnaire

ICIQ-SF questionnaire (Bristol) recommended by EAU

(v) Pad testing

Short-term standardised (1 hr) vs. long-term (1 day)

Short test = 500ml fluid, various exercises, increase in pad weight > 10g equals severe stress incontinence. High false negative rates; better with long-term testing but no relation to outcome of Rx. Not recommended by NICE

(vi) Urodynamics

Studies comparing symptoms with UDS findings have shown that:

Only 10% of women who deny UUI on history demonstrate bladder overactivity on UDS (NPV = 90%). Forms basis for NICE recommendation that UDS not required for straightforward 'lone' SUI

Up to 30% of women who deny SUI demonstrate it on UDS

No evidence that pre-op UDS improves Rx outcome for incontinence

Not recommended prior to commencing conservative therapy

Nevertheless widely believed to be beneficial prior to surgery

Multichannel recommended vs. single channel

Indication for urodynamics

Mixed symptoms (suspicion of OAB)

Previous failed incontinence surgery

Suspicion of neuropathic bladder or voiding dysfunction

Differentiating 'lone ISD' from ISD with hypermobility

Urodynamic valsalva leak point pressure (VLPP) < 60 cm water believed to be diagnostic [ 60-90 equivocal; > 90 excludes diagnosis]\*

Urethral pressure profile (Urethral pressure – detrusor pressure) < 20cm water

VLPP and UPP controversial. **Conflicting evidence that low VLPP or UPP predicts failure following sling/tape procedures.** Possibly due to standardisation difficulties. Not currently recommended.

\* VLPP should be differentiated from Detrusor LPP (leakage of urine from bladder in absence of abdominal contraction; DLPP > 40cm water suggests possible UUT dilatation)

NB. No evidence for routine cystoscopy, except in the presence of dipstick haematuria (Cardozo 0/200). No evidence for the routine use of imaging, except USS for the determination of PVR

**Management of Stress Urinary Incontinence**

Overview

Conservative

Weight loss\*

Lifestyle modification (weightlifting, firebreathing, etc.)

PMFT

Biofeedback

Medical

Topical vaginal oestrogen

Duloxetine

Surgical

Periurethral support procedures (**Supportive**)

Mid-urethral tape

Colposuspension

Autologous sling

### Sphincter augmentation (**Occlusive**)

Bulking agents

Artificial sphincter

\* obesity strongly correlates with SUI and OAB

### Conservative treatment

#### (i) Pelvic floor muscle training (Kegel exercises)

Originally described by Kegel using perineometer

Up to 50% of women cannot identify pelvic floor muscles

Proven efficacy for treatment in all women with SUI - subjective cure

rates ~ 30-40%; objective cure rates ~50%

Proven effective prophylaxis only in pregnant primips

8+ contractions tds for 3 months+ recommended by NICE

No evidence that vaginal cones, biofeedback or electrical stimulation better than PFMT alone

Electrical stimulation (E-Stim; requires vaginal probe) and magnetic therapy (Neotonus; EM waves generated by special chair – no vaginal probe required) only recommended for women unable to identify and adequately contract pelvic floor. No conclusive proof of efficacy (i.e vs. sham treatment)

### Medical treatment

#### (ii) Topical vaginal oestrogen

Improves 'hammock' tone and urethral mucosal coaption

A number of PC-RCTs have shown improvements for topical vaginal oestrogen vs. placebo in terms of frequency and SUI episodes. Only short-term follow-up however. Response rate ~50%

Generally well-tolerated. Side-effects vaginal burn, itch, spotting

Risks of malignancy with long-term oestrogen treatment – (BNF)

No evidence for systemic oestrogens – may make SUI worse

#### (iii) Duloxetine (Yentreve; Eli Lilley)

Serotonin (5-HT) and NA reuptake inhibitor (SNRI)

Acts chiefly in sacral spinal cord to increase pudendal nerve activity

Licensed for moderate to severe SUI (? how to classify) in 2 doses, 20mg bd and 40mg bd.

Cochrane database review (Mariappan 2006) of efficacy

Reduced leakage episodes, voiding interval and QOL

Significant side-effects (nausea, vomiting, dizziness, dry mouth, constipation) in ~30%; withdrawal in ~10%

Not recommended as first or second-line treatment by NICE: useful alternative in those unfit for surgery

### Surgical treatment

#### Factors to consider before surgery for SUI

- What is the relative contribution of urethral hypermobility and ISD?
- Does the patient have impaired detrusor contractility?
- The need for repair of genital prolapse, hysterectomy or fistula repair.
- The patient's life style, age, medical co-morbidities and expectations

Rapid expansion in numbers of surgical procedures for SUI since 1998 entirely due to the evolution of mid-urethral tape surgery at the expense of colposuspension

Generally procedures may be divided into those which provide periurethral support, and those which augment urethral closure. (NB. ? tape vs. tight tape)  
Evidence in SUI hampered by poorly designed trials with little consistency in terms of patients inclusion, exclusion criteria, and outcome measures

#### A. Periurethral support procedures

Typically for patients with urethral hypermobility rather than ISD. Some departments use VLPP > 90cm water as indication for periurethral support procedures, although pubovaginal sling surgery a/w increased morbidity and complications. Divided into suspension vs. backplate procedures:

##### (i) Suspension procedures

Burch colposuspension, Marshall-Marchetti-Kranz (MMK), Raz suture, Stamey suture, etc.

All designed to attach the periurethral support tissues to fixed structure, preventing descent

Suture procedures a/w poor long-term efficacy of ~30%. Lap colposuspension originally a/w poor long-term results cf. open (60% vs. 93% cure at 3 yrs Burton 1997) but now equivalent.

MMK - BN hitched up to periosteum of pubic symphysis - not recommended due to osteitis pubis

Vagino-obturator shelf repair – vagina anchored to obturator internus fascia – poorer results cf. Burch

Open Burch colposuspension therefore considered gold-standard; long-term efficacy 85-90%.

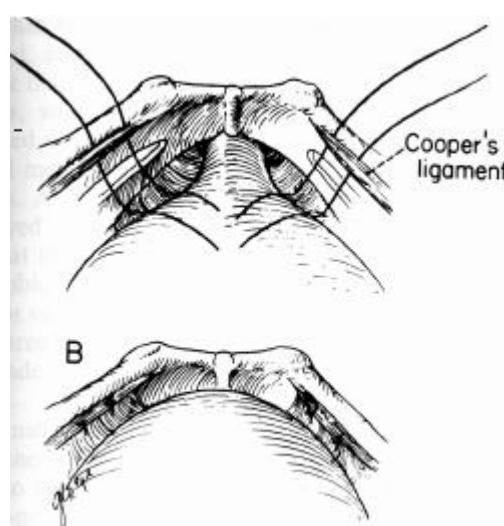
#### Burch colposuspension

Requires adequate vaginal length and mobility

Approximation of paravaginal tissues to iliopectineal line (ligament of Cooper).

Typically 2-4 sutures on each side – critical not to tie sutures too tightly

Non-absorbable sutures a/w erosion into bladder – use polydioxanone



Approximately 85% objective cure rate (Janis metaanalysis)

Complications of colposuspension:

General surgical complications	
Haematuria	
De-novo instability	30%
Retention	10% (half spontaneously resolve)
Vaginal prolapse	20% (majority asymptomatic)
Post-colposuspension syndrome	10% (leg/groin pain)

## (ii) Backplate procedures

Designed to re-create firm support tissue behind posterior urethra, thus preventing descent and allowing closure of urethra with raised intra-abdominal pressure (remember Abrams hosepipe analogy)

May be slings or tapes, biological or synthetic. Typically for women with 'simple' SUI without a history of previous surgery, synthetic tapes first line.

Classification of TVT

Type 1	Macroporous monofilament > 75um (polypropylene)
Type 2	Microporous monofilament < 10 um (expanded PTFE)
Type 3	Macroporous multifilament
Type 4	Submicron porous (silicon)

Synthetic tapes

Macroporous (>75um allowing ingress of fibroblasts, collagen and BV; prolene mesh), microporous (<10um; gore-tex); or submicron (<1um; silastic)

**Macroporous 'bottom-up' mesh a/w best efficacy with lowest complication rates – recommended by NICE**

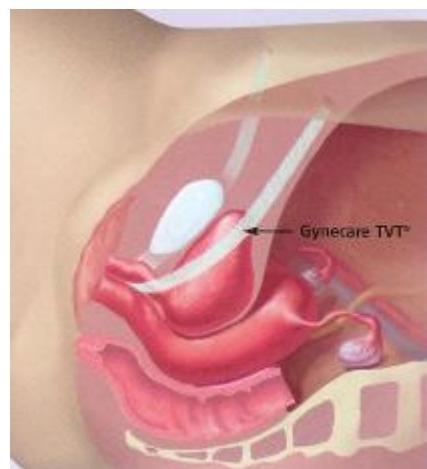
Long-term follow-up of TVT recently described by Nilson et al

90% objective cure

77% subjective cure

20% subjective improvement

Long-term results of top-down and TOT awaited



Complications

Failure	10%
Acute/chronic retention	5-10%
Urinary tract infection	5%
Perforation	5%

Overactive bladder	5%
Severe voiding dysfunction	2%
Haemorrhage/haematoma	1%
Erosion	1%
Wound infection	1%

\* Many patients taught ISC before TVT. If AUR develops options are threefold: immediate loosening of tape in theatre; ISC or IDC. Even without immediate revision, majority of patients settle spontaneously. <10% ultimately require tape division. Interestingly 30% remain dry Outcomes similar in young vs. old women except for slightly higher rates of de-novo bladder overactivity in the elderly population

\*\*All eroded material must be excised an tissue coverage performed Complications specific to TOT include leg pain (inadvertent insertion through adductor longus tendon) and higher rates of vaginal fornix perforation. TOT – obturator canal lies in upper outer corner of obturator foramen

### B. Augmentation of urethral closure

Usually reserved for patients suspected of having intrinsic sphincter deficiency. VLLP < 60 cm water.

#### (i) Periurethral bulking agents

Typically for Type III SUI (no descent; lone ISD)

More effective than no treatment/placebo but inferior to surgery (autologous sling): fewer complications however

Little difference between collagen, carbo-coated zirconium beads, hyaluronic acid/dextran co-polymer (Deflux), silicone (polydimethylsiloxane, aka macroplastique)

Autologous fat no better than placebo PTFE microparticles a/w migration

Collagen a/w hypersensitivity reactions

Problems (NICE)

Repeat injections required to achieve efficacy

Efficacy diminishes over time

Not as effective as sling

Complications common but transient: include AUR and de novo bladder overactivity

#### (ii) Pubovaginal slings

Indications

SUI with significant ISD component

Sacral neurogenic bladder (spina bifida)

Erosion, fistula or tissue loss

Failed mid-urethral tape

Ongoing requirement for ISC

Poor bladder compliance considered a contraindication – risk hydronephrosis

Different degrees of ‘tightness’ for different patients

Four different types:

Autograft

Autologous rectus fascia, fascia lata

Autografts almost never a/w erosion

Rectus fascia better cf fascia lata – no requirement for repositioning and no leg symptoms

**Allograft**

Cadaveric dura mater, cadaveric fascia lata, acellular dermis

No difference between substances

Sterilisation by solvents, freeze-drying or radiation

No

Risk of HIV 1 in 8 million

Risk of CJD 1 in 3.5 million

**Xenograft**

Porcine small bowel submucosa, bovine pericardium

Porcine small bowel mucosa a/w reduced immunological response

**Synthetics**

Autologous material better cf. cadaveric material and prior to TVT was considered gold standard.

**Surgical technique**

6-8cm of rectus fascia harvested

Space of Retzius entered

Vaginal incision at bladder neck

Suture passer top down

Siting of autograft at bladder neck and proximal urethra

Suture with vicryl to endopelvic fascia on either side

NB. 'tight' closure may be achieved by crossover technique

**Complications**

Urinary retention\* 20-40%

Abdominal pain up to 100% (resolves with suture hydrolysis)

Erosion Very rare

Failure Rare (early technical; late 2' prolapse)

\* Transection if within 6 weeks; if urethra hypersuspended complete removal required

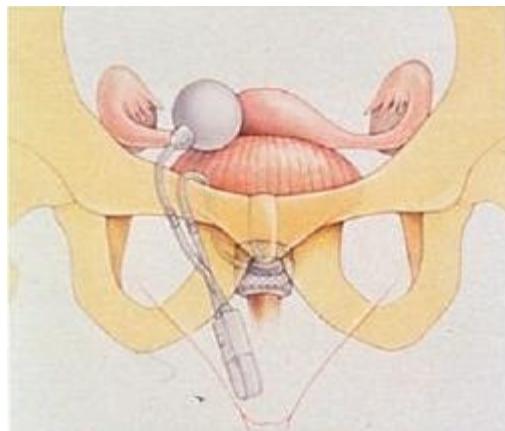
Very high cure rates can be expected (93% at 22 months McGuire ; 98% for revisions)

**(iii) Artificial urinary sphincter**

Indicated for Type 3 SUI

High subjective cure rates > 90% (Kowalczyk 2000) but significant erosion rates 7-29%

Therefore only recommended for previous failed SUI surgery



Which technique is best?

TVT better than colposuspension (Novara 2007)

TVT just better than fascial sling (Novara 2007)

TVT = TOT (Freeman 2008)

TOT outside in better than inside out

Fascial sling better than colposuspension (Albo 2007)

Revision surgery

Many centres would place 2<sup>nd</sup> tape

Equivalent efficacy and complication rate to primary procedure

Others recommend Burch or Fascial Sling

Albo (NEJM) 2007 (n=655) showed autologous fascial sling more effective than Burch, but a/w higher risk of side-effects and revision for voiding dysfunction

## **Overactive bladder (OAB) and urge urinary incontinence**

Overactive bladder is a symptom profile characterised by urinary frequency, nocturia and urgency with or without urge urinary incontinence

### Evaluation

#### History

- Fluid intake
- Caffeine
- Smoking
- Diabetes

#### Examination

- Exclude demonstrable stress incontinence
- Exclude palpable bladder

#### Voiding diary

#### Post-micturition residual

#### Urinalysis

- Non-visible haematuria in the absence of UTI/menstruation mandates investigation

#### Urinary cytology (?)

#### Urodynamics

### Management

#### (i) Conservative

- Caffeine withdrawal
- Bladder retraining (6 week course)
  - More effect than control in RCTs
  - As effective as oxybutynin but with lower relapse and fewer SE
  - Anticholinergic plus retraining = reduced freq. but equal incontinence episodes
- Prompted and timed voiding reduce incontinence in cognitively impaired

#### (ii) Pharmacological

##### Topical oestrogen therapy

Intravaginal oestrogens are recommended for the treatment of OAB (overactive bladder) symptoms in post-menopausal women with vaginal atrophy (NICE 2006)  
Vagifem Vaginal Tablets (or Orthogynest Intravaginal cream): Insert one tablet (or applicator full) daily for two weeks, then reduce to one tablet (or applicator full) twice weekly

At one year oestrogen pessaries reduces urinary incontinence by half (20% to 10%) and frequency by three quarters (40% to 10%)

##### Anticholinergics

Vast amount of data

Cochrane review (Herbison 2003) included 32 RCTs, conclusively proving anticholinergics decrease frequency and urgency, increasing mean bladder functional capacity

### Overall efficacy 50-75%

Very little difference between formulations in terms of efficacy – differences promulgated by drug companies often have no ‘real world advantage’. Solifenacina may have better efficacy in urge incontinence (Star trial Chapple)

Effects in elderly (BBB) can be profound

NICE recommend non-proprietary immediate release (IR) oxybutynin first line (>60 yrs 2.5mb bd; otherwise 5mg bd up to qds)

If poorly tolerated then tolterodine, solifenacina, darifenacina, trospium, or transdermal oxybutynin. Tolterodine reserved for troublesome side-effects; trospium for CNS side-effects, and solifenacina for treatment failures – some rationality for this.

Propiverine, flavoxate, propantheline and imiprimine not recommended by NICE

#### Contraindications

Myasthenia gravis

Narrow-angle glaucoma

Toxic megacolon

Bowel obstruction

#### Half-lives

Tolterodine	2-4 hrs
-------------	---------

Oxybutynin	2-3 hrs
------------	---------

Tolterodine XL	8.5 hrs
----------------	---------

Oxybutynin XL	13 hrs
---------------	--------

Trospium	20 hrs
----------	--------

Solifenacina	40 hrs
--------------	--------

### Desmopressin

Highly effective in reducing nocturia and ‘nocturnal bother’ in adults, with sustained long-term responses

No evidence for its use in reducing daytime incontinence

Oral and intranasal preparations equally effective but neither licensed in UK for this use

#### Side effects

Headache, nausea and daytime urinary frequency

Mild hyponatraemia in ~10% - may be more common in elderly (post-Rx monitoring for 3 days recommended if given to over 60s)

### Intravesical Botulinum toxin

Binds to pre-synaptic nerve terminals, leading to inhibition of ACh release and failed neuromuscular transmission

Specifically stops endovesicles fusing with plasma membrane by cleaving cytosolic translocation SNARE proteins

Botulinum toxin A only recommended (short duration of response with botulinum toxin B

2 preparations in botulinum toxin A in UK (BOTOX - Allergan, Dysport - Ipsen). Different dosages – not interchangeable.

Typically 10IU/ml BoTox 20-30 injections of 1 ml (fan-shaped distribution 5 columns x 4-6 trigone-sparing) into detrusor.  
 Usually 200 IU for IDO and 300 IU for NDO  
 Evidence (Dmochowski metaanalysis 2007)

	Improvement	Continence	ISC	Duration
IDO 21 studies 1 x RCT	60-100%	34-100%	0-75%	Mean 6/12
NDO 21 Studies 1 x RCT	66-100%	57-87%	0-69%	Mean 6/12

#### Problems

Infection, bleeding, dysuria, AUR, incomplete emptying  
 Requirement for repeat treatment

#### Surgical treatment

Sacral nerve neuromodulation (Sacral nerve stimulation)

Medtronic ® InterStim Sacral Nerve Stimulation (SNS)  
 System™, Minnesota, USA

Permanent stimulation of S3 nerve root (dorsal division – usually unilateral only) thought to inhibit reflex detrusor contraction – mechanism unknown (? gating theory)

S3 stimulation

Motor	dorsiflexion great toe, contraction levator ani
Sensory	Pulling sensation in rectum, scrotum, vagina

Initial percutaneous nerve evaluation (PNE) for a few days with external stimulator, followed by implantable SNS in those who respond

Around **two-thirds of patients have sustained response** (both incontinence episodes and frequency-urgency) for at least 3 years (similar efficacy in those with Fowler's syndrome)

However definitions of response vary making it difficult to determine true efficacy. Conventionally at least 50% improvement in symptoms considered success.

Complications common

- Pain at implant site
- Leg pain
- Infection
- Urinary retention
- Bowel function disturbance

**Revision in one third** (lead migration, malfunction)

Removal in 10%

Cost can be prohibitive: Hardware costs £8400; Battery change at ~ 5-7 years costs £5300. NICE estimated £25,000 per QALY  
 Currently NICE only recommend for patients with NDO or IDO, not non-obstructive voiding dysfunction

NB. S3 foramen located 1cm below and lateral to posterior sacral prominence (PSP). PSP located 4 fingers breadth above tip of coccyx

### Augmentation cystoplasty

Typically ileal segment (25cm, 25cm from ileocaecal valve), occasionally ileocaecal or sigmoid

No RCTs – case series report cure/improvement in 50-75%

Side effects common however

Recurrent UTI	35%
Voiding dysfunction /ISC	30%
Increased bowel frequency	20%
Metabolic acidosis	15%
Calculus formation	15%
Incontinence	10-12%
Perforation	<1%
Malignancy	<1%

Mucus production (30-40g per day)

### Detrusor myomectomy

Excision of muscle to leave mucosa as a wide-necked diverticulum

No pure studies in idiopathic DO; all ‘contaminated with neurogenic DO patients

From limited case series, improvement expected in >75%

Requirement for ISC in approximately one third

### Urinary diversion

Uncommonly performed for idiopathic DO

Typically ileal conduit UD; occasionally pouch, rectal bladder

SE due to urinary diversion + ~50% vesical infection/pyocystis

## Incontinence in the Elderly (DIAPPERS)

Cause	Comments
Delirium/confusional state	Results from almost any underlying illness or medication; incontinence is secondary and abates once the cause of confusion has been corrected
Infection—urinary (only symptomatic)	Causes incontinence, but the more common asymptomatic bacteriuria does not
Atrophic urethritis/vaginitis	Characterized by vaginal erosions, telangiectasia, petechiae, and friability; may cause or contribute to incontinence. Now controversial but may be worth a 3- to 6-month trial of estrogen, especially local (if not contraindicated by breast or uterine cancer)
Pharmaceuticals	Includes many prescribed and nonprescribed agents, because incontinence can be caused by diverse mechanisms (see Table 71-2 )
Excess urine output	Results from large fluid intake, diuretic agents (including theophylline, caffeinated beverages, and alcohol), and metabolic disorders (e.g., hyperglycemia or hypercalcemia); nocturnal incontinence also may result from mobilization of peripheral edema (e.g., congestive heart failure, venous insufficiency)
Restricted mobility	Often results from overlooked, correctable conditions such as arthritis, pain, postprandial hypotension, or fear of falling
Stool impaction	May cause both fecal and urinary incontinence that remit with disimpaction

Type of Medication	Examples	Potential Effects on Continence
Sedatives-hypnotics	Long-acting benzodiazepines (e.g., diazepam, flurazepam)	Sedation, delirium, immobility
Alcohol		Polyuria, frequency, urgency, sedation, delirium, immobility
Anticholinergics	Dicyclomine, diphenhydramine, antihistamines (sedating ones only, e.g., diphenhydramine [Benadryl])	Urinary retention, overflow incontinence, delirium, impaction
Antipsychotics	Thioridazine, haloperidol	Anticholinergic actions, sedation, rigidity, immobility
Antidepressants (tricyclics only)	Amitriptyline, desipramine; <i>not</i> selective serotonin reuptake inhibitors	Anticholinergic actions, sedation
Anti-parkinsonians	Trihexyphenidyl, benztropine mesylate ( <i>not</i> L-dopa or selegiline)	Anticholinergic actions, sedation
Narcotic analgesics	Opiates	Urinary retention, fecal impaction, sedation, delirium
$\alpha$ -Adrenergic antagonists	Prazosin, terazosin, doxazosin	Urethral relaxation may precipitate stress incontinence in women
$\alpha$ -Adrenergic agonists	Nasal decongestants	Urinary retention in men
Calcium channel blockers	All dihydropyridines	Urinary retention; nocturnal diuresis due to fluid retention
Potent diuretics	Furosemide, bumetanide ( <i>not</i> thiazides)	Polyuria, frequency, urgency
NSAIDs	Indomethacin, cyclooxygenase-2 inhibitors	Nocturnal diuresis due to fluid retention
Thiazolidinediones	Rosiglitazone, pioglitazone	Nocturnal diuresis due to fluid retention
Parkinson's agents (some)	Pramipexole, ropinirole, amantadine	Nocturnal diuresis due to fluid retention
Angiotensin-converting enzyme inhibitors	Captopril, enalapril, lisinopril	Drug-induced cough can precipitate stress incontinence in women and in some men with prior prostatectomy
Vincristine		Urinary retention owing to neuropathy

## Appendix

### Mechanism of continence in women

4 factors contribute to female continence:

- Bladder compliance
- Efficient urethral sphincter
- Efficient urethral support
- Adequate urethral mucosal co-apton

3 components of urethral support in women (from true pelvis to perineum)

- Suburethral 'hammock' of connective tissue
  - Allows efficient transfer of raised intraabdominal pressure
- Endopelvic fascia (condensations of which termed ligaments)
  - Arcus tendineus facia pelvis
  - Levator ani musculature
    - Particularly pubourethralis
    - Intrinsic tone re-inforces pelvic ligaments

